m., area No. XIV again appeared central in Montana, but by the 25th, p. m., it finally disappeared in Minnesota; it had, of course, during these three days gradually filled up as a barometric depression and broken up as a cyclonic whirl. At the southern end of this general depression the lowest pressure that occurred at Yuma, Ariz., on the 20th, p. m., stretched northward into Nevada on the 22d, a. m., at which time, however, an indefinite low, with opposing winds, existed in western Texas; this latter may be called low No. XV and, by the 25th, a. m., it had disappeared in southern Texas.

The indefinite nature and unimportant phenomena attending lows Nos. XIV and XV do not make them less worthy of study and of numeration in our list of lows, since under slightly different circumstances similar unimportant areas develop into the severest storms, and the reappearance of No. XIV on the 24th, a. m., is a crucial test of imperfect theories as to the cause of low pressures.

XVI.—Pressure fell rapidly on the 25th in Oregon and Washington, and a decided depression was evidently moving eastward or southeastward toward that coast, but as it was central in British Columbia on the 26th and was then moving southeastward, it is likely that on the 25th, a. m., the main depression was far northwest of Oregon. This depression was the most important of the month for that section of the country and brought heavy rain, with high southerly winds, on the 25th and 26th to northern California, Oregon, and Washington. A notable feature was the occurrence of a tornado at Seattle—a very rare phenomenon in Washington. By the 26th, p. m., pressure had begun to rise on the Pacific coast and the lowest pressure was central at Calgary, in Alberta, and extended as a narrow trough throughout that province and southeastward into northwestern Nebraska. Rain continued during the 27th at most stations in the Pacific States, with increasing westerly winds and rising barometer, and the central depression remained in Alberta, while the trough steadily maintained its dimensions, and, by the 27th, p. m., had begun the formation of two separate whirls and low areas, respectively located in eastern Wyoming (XVII) and in Alberta (XVI). The latter remained nearly stationary until the 28th, p. m., as far as can be judged from the few reports that we receive from this region, but by the 29th, a. m., it had moved decidedly eastward and subsequently moved southeastward, extending as a long trough so as to maintain its connection with area No. XVII.

In connection with low area No. XVI on the 26th, a. m., the special dispatch, "Conditions favorable for severe local storms during Friday," was sent to the observers at Bismarck, Williston, Sioux City, Valentine, Rapid City, Yankton, and Pierre.

XVII.—The southern area, No. XVII, which was in Wyoming on the 27th, p. m., moved slowly eastward; it was almost entirely obliterated on the 29th, but was replaced on the 30th in Colorado by a new whirl in its own previous location, which by the 30th, p. m., was central in eastern Nebraska, and is to be considered as included in the same general depression that then extended northward, and also covered No. XVI.

In connection with the beginning of this low area, and on the 28th, p. m., when it was central in western Nebraska, a special warning of severe local storms was sent to observers at Des Moines, Sioux City, Omaha, Yankton, Huron, and Valentine.

NORTH ATLANTIC METEOROLOGY.

[*Pressure in inches and millimeters; wind-force by Beaufort scale.*]

The normal barometric pressure for April over the North Atlantic Ocean, as deduced from international simultaneous observations, is highest, 30.10 to 30.14 (764 to 766), in a belt extending from the west coast of Africa between N. 18° and N. 28°, westward to W. 49°; a corresponding so-called tropical belt prevails on the Pacific Ocean, west of the peninsula of Lower California. The region of lowest pressure, 29.80 to 29.75 (757 to 756), includes Iceland and the southern end of Greenland, and extends from N. 50° and W. 40° to N. 75° and E. 5°; a still lower area of low pressure apparently exists in the North Pacific Ocean, from the southern portion of Alaska westward along the Aleutian Archipelago to W. 165°. The average of this month shows an area of high pressure, 30.10 by 30.20, extending from the interior of British America, at N. 55°, W. 90° to 110°, northward to about N. 70°, W. 100° to 120°; another area of high pressure apparently exists at the northern end of Smith Sound, and to these areas may be added another of 30.10 to 30.20 in Siberia between N. 55° and 70°, E. 90° and 130°. It will be seen that the high pressures in these Arctic regions have steadily diminished since February and are, in April, just about to disappear and be replaced by low pressures in June. These pressures are as given by the mercurial barometer under the influence of local gravity, and need to be increased by 0.07 in order to be expressed in terms of standard gravity.

As compared with March the normal pressures in April are lower by 0.10 in a zone extending from Saskatchewan northwest to the mouth of the McKenzie, at N. 70°, W. 135, and are lower by 0.20 in eastern Siberia and northern China, but less by 0.15 in western Europe; they are higher by 0.25 at North Cape and Nova Zembla.

The departures of the monthly means for April from the annual means for each individual station show a deficit of 0.10 over the Atlantic Ocean south and southeast of Newfoundland, and extending thence over Spain, France, and the Mediterranean, and in general a deficit exists from the equator northward to N. 50° around the whole earth, but an excess prevails north of the zone between N. 50° and N. 70°.

The normal zone of the maximum frequency of storm paths passes from the coast of China, at N. 40°, westward to Japan, thence northeastward along the Japanese and Kurile Islands, crossing Bering Sea to Alaska, attaining N. 58° at W. 152°, thence southeast over British Columbia to Utah, thence eastward to Massachusetts and northeast to Ireland, where it divides toward northern and southern Europe. The regions of maximum frequency seem to be over the Great Lakes, with an average of 2.4 storm tracks per month for each region of 5° square, and, again, east of Newfoundland, with a frequency of 3.0. Low centers occur most frequently over the Missouri Valley and eastern slope of the Rocky Mountains, but many of these are imperfectly developed and dissipated before becoming severe storms.

The normal velocity of storm centers during April is 26 miles per hour in the United States, 20 miles over the Atlantic Ocean, and 18 miles in Europe.

NORTH ATLANTIC STORMS.

The following paragraphs give some account of the areas of low pressure and strong winds on the Atlantic Ocean during April, 1894. Daily charts are compiled at the Weather Bureau showing the United States and European conditions as nearly as practicable at Greenwich noon; these are supplemented by simultaneous data for the ocean received through the co-operation of the Hydrographic Office of the

U. S. Navy Department and the New York Herald Weather Service. From 75 to 100 daily reports from the most frequented portion of the Atlantic Ocean give a basis for approximating to the locations and paths of the more important storms passing between America and Europe.

A. This was a continuation of (*M*) of the north Atlantic series for March. On the 1st, at Greenwich noon, this center was near N. 55°, W. 25°; 2d, N. 52°, W. 16°; 3d, N. 50°, W. 10°; this depression was now almost entirely broken up, and disappeared as it passed eastward into the Bay of Biscay.

B. This was a continuation of United States series No. I, and was central on the 1st, noon, at the mouth of the St. Lawrence; 2d, noon, southern coast of Newfoundland; 3d, noon, extended as a trough between N. 40° and N. 50°, W. 53° and W. 48°; 4th, noon, central N. 50°, W. 35°; 5th, noon, extended as a trough from N. 45°, W. 25°, to N. 55°, W. 30°; 6th, noon, it seems to have separated into two portions, of which the principal one was at N. 45°, W. 20°; 7th, noon, the latter of these two was central at N. 40°, W. 15°, after which it disappeared.

C. This was a continuation of U. S. series No. II, which was central north of Lake Superior on the 4th, noon; 5th, noon, central near the mouth of the St. Lawrence; 6th, noon, at N. 47°, W. 58°; 7th, noon, N. 44°, W. 56°; 8th, noon, N. 50°, W. 42°; 9th, N. 52°, W. 25°; 10th, N. 58°, W. 20°, after which it disappeared in the presence of the extensive area of high pressure that had been advancing eastward over Europe since the 1st of the month.

D. This area developed off the coast of the United States on the 7th and 8th and is number VII of the U. S. series. It was central on the 8th at about N. 38°, W. 72°; 9th, at N. 44°, W. 63°; 10th, N. 43°, W. 55°; 11th, N. 45°, W. 47°; 12th, N. 48°, W. 35°; 13th, N. 52°, W. 20°; 14th, N. 54°, W. 25°; 15th, N. 54°, W. 20°; 16th, N. 53°, W. 14°; 17th, N. 57°, W. 5°; at this time the isobar 29.5 extended far north of Scotland and southward to the Bay of Biscay, over which a minor depression was central and a third depression was forming in the Mediterranean; 18th, noon, the northern and the Mediterranean depressions had disappeared and the principal low pressure was central in France.

E. This was a continuation of low Nos. VI and VII of the U. S. series that passed from Michigan to the coast of Virginia on the 10th; 11th, noon, at N. 38°, W. 73°; 12th, noon, N. 40°, W. 72°; 13th, N. 51°, W. 66°; 14th, noon, N. 42°, W. 64°; 15th, N. 38°, W. 61°; 16th, N. 39°, W. 57°; 17th, N. 42°, W. 58°; 18th, N. 44°, W. 50°; 19th, N. 47°, W. 42°; 20th, N. 52°, W. 35°; 21st, N. 55°, W. 29°; 22d, N. 56°, W. 18°; the central depression that we have thus far followed seems to have died out by the 23d, and to have been replaced by a more important one that had formed at the southwestern end of the general depression in which it was located; this new depression was central on the 23d at N. 46°, W. 21°; by the 24th these two depressions were represented by one center at N. 53°, W. 12°, while southwest winds of force 11 were prevailing off the coast of Ireland; 25th, N. 55°, W. 12°; 26th, N. 56°, W. 11°; 27th, noon, the general depression had extended slightly east and south, but the central area of lowest pressure was now represented by three or more areas of moderate depression over Great Britain and the North Sea; 28th, a moderate depression covered central Europe with several centers; on the 29th and 30th this depression moved southeastward over the Mediterranean.

F. This was a continuation of U. S. series Nos. XI and XII. No. XI was central in the St. Lawrence Valley on the 21st, and No. XII passed over the middle Atlantic States on the 22d, and New England on the 23d; (*F*) was central on the 24th about N. 43°, W. 66°; 25th, N. 45°, W. 57°; 26th, N. 50°, W. 52°; 27th, N. 50°, W. 43°; on the 28th this depression was entirely north of our reports.

G. This depression developed over the Atlantic on the 28th; 29th it was central at about N. 45°, W. 55°; 30th, N. 45°, W. 49°, while an area of unusually high pressure prevailed to the eastward.

OCEAN FOG FOR APRIL, 1894.

The limits of fog belts west of the fortieth meridian, as reported by shipmasters, are shown on Chart I by dotted shading. East of the fifty-fifth meridian fog was reported on 22 dates; between the fifty-fifth and sixty-fifth meridians on 18 dates; and west of the sixty-fifth meridian on 11 dates. Compared with the corresponding month of the last six years, the dates of occurrence of fog east of the fifty-fifth meridian numbered 8 more than the average; between the fifty-fifth and sixty-fifth meridians, 8 more than the average; and west of the sixty-fifth meridian, 1 more than the average.

OCEAN ICE IN APRIL, 1894.

The following table shows the southern and eastern limits of the region within which icebergs or field ice were reported for April during the last 12 years:

Southern limit.			Eastern limit.		
Month.	Lat. N.	Long. W.	Month.	Lat. N.	Long. W.
	° ′	° ′		° ′	° ′
April, 1883	40 49	52 06	April, 1883	48 00	43 00
April, 1884	41 26	48 46	April, 1884	45 25	43 34
April, 1885	41 40	49 50	April, 1885	44 10	39 41
April, 1886	40 51	46 39	April, 1886	*47 43	30 11
April, 1887	40 02	50 04	April, 1887	48 00	38 18
April, 1888	41 33	50 00	April, 1888	47 40	49 00
April, 1889	43 57	50 20	April, 1889	47 16	43 11
April, 1890	40 00	49 40	April, 1890	47 26	35 42
April, 1891	40 01	48 24	April, 1891	45 33	43 32
April, 1892	42 46	49 37	April, 1892	48 58	44 27
April, 1893	42 28	50 14	April, 1893	46 50	46 05
April, 1894	42 00	51 10	April, 1894	44 56	44 00
Mean	41 28	49 14	Mean	46 50	41 43

* Isolated iceberg.

The limits of the region within which icebergs or field ice were reported for April, 1894, are shown on Chart I by crosses. The southernmost ice reported, a large berg, observed on the 16th in the position given, was about one-half of a degree north of the average southern limit, and the easternmost ice reported, one large berg and a few smaller ones on the 1st in the position given, was about two and one-half degrees west of the average eastern limit.

Compared with April, 1893, there was a marked increase in the quantity of ice reported. Ice was reported every day during the month except on 13th to 15th.

On the 7th the British bark *Ruth Palmer* collided with an iceberg off the Grand Banks and sunk. The crew were picked up by the French brigantine *Marie Gabrielle*, and landed at St. Pierre, Newfoundland, 30th.

On the 12th the French steamship *Olbia* landed at St. Pierre, much damaged by striking an iceberg on the voyage from Marseilles.

On the 17th the British steamship *Earncliffe* arrived at Halifax so much damaged by ice met outside of Halifax harbor that she will have to go into dry dock. Extensive reefs of heavy field ice were reported on the eastern coast of Newfoundland.

On the 18th the British steamship *Valletta*, bound for St. John, N. B., foundered in the ice 50 miles east of Halifax. Her crew were saved by the Norwegian bark *Liberté*.

Reports state that easterly gales have packed heavy ice on the shore and in the harbors of Cape Breton Island, blocking navigation even on the southern coast. It is reported that ice was very heavy in the Gulf of St. Lawrence on the 18th. British steamship *Newfoundland*, which for several days had been jammed in the ice off Cow Bay, C. B. I., got clear April 19th, and proceeded to Halifax, N. S. British

steamship *Premier* was unable to reach her destined port, Montreal, on account of ice, and returned to Halifax.

On the 22d reports state that Halifax harbor was completely blocked by heavy Gulf ice. Six steamers and 50 sail vessels were detained in port on account of ice. No such blockade has occurred in the past forty-two years.

On the 24th British steamship *Sarmatian*, from Liverpool to Montreal, stopped at Halifax, being unable to get up the Gulf of St. Lawrence on account of ice. Leaving Halifax on the 25th, she encountered heavy field ice 60 miles northwest of Bird Rocks. She met pack ice 12 feet thick, covered with seals.

On the 26th the British schooner *Algeria* had her bows crushed in by the ice and sunk while attempting to make Renews Harbor, south of St. Johns, N. F.

On the 30th the British steamship *Pomeranian*, in N. 48° 10′, W. 62° 30′, sighted two fields of pack ice and a schooner fast in the middle of one of them.

TEMPERATURE OF THE AIR.

[*In degrees Fahrenheit.*]

The distribution of the monthly mean temperature of the air over the United States and Canada is shown by the dotted isotherms on Chart II; the lines are drawn over the high irregular surface of the Rocky Mountain plateau, although the temperatures have not been reduced to sea level, and the isotherms, therefore, relate to the average surface of the country occupied by our observers; such isotherms are controlled largely by the local topography, and should be drawn and studied in connection with a contour map.

NORMAL TEMPERATURE.

In Table II, for voluntary observers, the mean temperature is given for each station, but in Table I, for the regular stations of the Weather Bureau, both the mean temperatures and the departures from the normal are given for the current month. In the latter table the stations are grouped by geographical districts, for each of which is given the average temperature and departure from the normal; the normal for any district or station may be found by adding the departures to the current average when the latter is below the normal and by subtracting when it is above.

MONTHLY MEAN TEMPERATURE.

For the regular stations of the Weather Bureau the monthly mean temperature is the simple mean of all the daily maxima and minima; for voluntary stations a variety of methods of computation is necessarily allowed, as shown by the notes appended to Table II.

During April, 1894, the mean temperature was highest (84) in southeastern California, and next highest (80) in the lower portion of the Valley of the Rio Grande; at Key West, Fla., the monthly mean was 76.6. The lowest temperatures were: At Canadian stations, 30.8 at Charlottetown, P. E. I.; 33.6 at Sydney, C. B. I.; 34.0 at Father Point, Quebec; 35.2 at Port Arthur, Ont.; 37.0 at Battleford, Saskatchewan. At United States stations the lowest temperatures were: 39.0 at Eastport, Me.; 37.8 at Duluth, Minn.; from 29 to 31 in the mountains of central Colorado; 49.6 at Denver, Colo.; and 44.5 at Tatoosh Island, Wash. The temperature averaged 32 at no point within the limits of our daily map, except on the peaks of the Rocky Mountains and in the central portion of the Gulf of Saint Lawrence.

DEPARTURES FROM NORMAL TEMPERATURE.

As compared with the normal for April, temperatures were in excess in the valleys of the Sacramento and San Joaquin, and at Yuma, Ariz., on the Colorado River; they were also in excess at nearly all stations from the Rocky Mountain Divide eastward to the Atlantic, but were deficient on the east coast of Nova Scotia, and were slightly so at a few stations on the immediate coast of Massachusetts, Connecticut, Virginia, North Carolina, South Carolina, and Florida; the principal deficit extended over the Rocky Mountain plateau and the coasts of Washington, Oregon, and California. The maximum excesses were: 5.5 at Escanaba, Mich.; 7.3 at Parry Sound, Ont.; 7.6 at Rockliffe, Ont.; 5.1 at Winnipeg, Man.; 4.6 at Marquette, Mich., and San Antonio, Tex.; 4.7 at Kingston, Ont.; 4.8 at Saugeen, Ont.; and 4.5 at Green Bay, Wis., and Abilene, Tex. The maximum deficits were: 3.6 at Walla Walla, Wash., and Portland, Oreg.

The departures from normal temperature for the current month, and by districts, are as follows:

Positive departures: New England, 0.6; middle Atlantic coast, 0.4; south Atlantic coast, 0.1; Key West, Fla., 0.6; east Gulf States, 1.0; west Gulf States, 1.7; Ohio Valley and Tennessee, 0.5; upper Lake region, 3.1; lower Lake region, 2.4; North Dakota, 2.8; upper Mississippi and Missouri valleys, 2.3; northern slope, 1.6; middle slope, 2.3; southern slope (Abilene), 4.5; southern plateau, 0.5; middle Pacific, 0.1.

Negative departures: Middle plateau, 1.3; northern plateau, 2.8; north Pacific coast, 2.2; south Pacific coast, 1.2.

The following table shows for certain stations, as reported by voluntary observers, (1) the normal temperature for April for a series of years; (2) the length of record during which the observations have been taken, and from which the normal has been computed; (3) the mean temperature for April, 1894; (4) the departure of the current month from the normal; (5) the extreme monthly means for April and the years of their occurrence during the period of observation:

State and station.	(1) Normal for the month of Apr.	(2) Length of record.	(3) Mean for Apr., 1894.	(4) Departure from normal.	(5) Extreme monthly means for April.			
					Highest.	Year.	Lowest.	Year.
	°	Years	°	°	°		°	
Arizona.								
Fort Apache	52.5	22	53.4	+ 0.9	59.5	1879	47.5	1884
Fort Mohave	70.8	23	.....	.....	77.1	1881	62.2	1891
Whipple Barracks	51.1	22	51.0	— 0.1	61.8	1876	45.4	1884
Arkansas.								
Keesees Ferry	61.7	12	60.5	— 1.2	65.3	1888	56.7	1884
California.								
Riverside	60.4	12	.....	.....	63.5	1885	57.8	1891
Colorado.								
Las Animas	51.3	12	53.2	+ 1.9	56.7	1888	46.2	1884
Florida.								
Merritts Island	72.0	12	72.8	+ 0.8	75.4	1883	67.0	1886
Georgia.								
Forsyth	65.3	20	66.5	+ 1.2	69.4	1893	61.0	1875
Idaho.								
Boise Barracks	49.9	20	51.0	+ 1.1	56.5	1888	44.2	1883
Fort Sherman	45.8	10	45.4	— 0.4	50.9	1889	41.8	1882
Indiana.								
Lafayette	50.6	14	52.5	+ 1.9	53.9	1886	45.4	1881
Iowa.								
Cresco	43.1	22	48.7	+ 5.6	48.7	1894	37.5	1874
Kansas.								
Eureka Ranch	54.5	11	56.5	+ 2.0	58.6	1888	49.8	1892
Independence	57.0	22	61.2	+ 3.6	61.7	1878	48.3	1874
Louisiana.								
Grand Coteau	69.7	11	72.0	+ 2.3	72.2	1893	68.0	1891
Maine.								
Orono	40.0	23	41.9	+ 1.9	45.1	1889	33.3	1874
Maryland.								
Cumberland	49.1	23	51.0	+ 1.9	57.6	1881	45.0	1874
Michigan.								
Kalamazoo	47.0	17	49.0	+ 2.0	52.9	1878	42.0	1881
Missouri.								
Sedalia	56.5	11	57.5	+ 1.0	61.5	1888	52.7	1885
Montana.								
Fort Custer	45.9	12	47.8	+ 1.9	50.6	1889	41.3	1893